



REM R TECHNICAL NOTE HY-N-1.1

GROUT-FILLED FABRIC BAGS AS A SUBSTITUTE FOR RIPRAP

PURPOSE: To provide information on grout-filled fabric bags and their use as a substitute for riprap.

APPLICATION: Grout-filled fabric bags can be used to provide protection downstream from stilling basins where scour can endanger the integrity of the structure.

ADVANTAGES: These bags can provide adequate scour protection in the turbulent flow environment downstream from stilling basins where riprap cannot be used due either to the extreme size required or to inability to obtain the size riprap required.

LIMITATIONS: During placement, flow must be diverted from the area where the grout-filled bags are being placed, although the area need not be dewatered. Field experience in handling the bags in areas below stilling basins is limited.

PERSONNEL REQUIREMENTS: Personnel requirements will be site-specific, but typically two divers are required if the bags are placed underwater. One diver is needed to direct the filling hose and another to inspect the bag as it is filling. In addition, an operator and laborer are required for operating the pumping equipment. An engineer is needed to supervise construction, and at least two laborers are needed to handle the bags and perform other supporting tasks. Personnel to supply the concrete are also required, the number depending on the method of delivery; i.e., concrete trucks or portable batch plant.

EQUIPMENT: Equipment requirements are site-specific, but generally consist of a floating work platform of three or four barges supported by one or more towboats. A crane to handle the bags and their frame, pumping equipment, and equipment to deliver the grout are also required.

BACKGROUND: Grout-filled bags were model tested at the Waterways Experiment Station during a study of scour protection required for Emsworth Locks and Dams on the Ohio River. Model results indicated that a wider range of operation would be possible if large grout-filled bags were used for scour protection instead of riprap or derrick stone 4 to 5 ft in diameter. The total weight of a grout-filled bag should equal or exceed the weight of a stable size riprap or derrick stone. The model results also indicated that the bags were more stable when placed longitudinally with the flow. The bags were placed end-to-end but overlapping should provide added protection.

During repair and rehabilitation of Emsworth in 1982 and 1983, derrick stone was placed in the scoured areas below the stilling basin. In September 1984, Pittsburgh District noted that the stone was missing downstream from gate bay 4.

It is believed that the stone failed during ice passage the previous winter. Emergency repair to the scoured area below gate bay 4 using grout-filled bags approximately 20 ft long by 7 ft wide by 3 ft high was completed in February 1985. This was the first known use of grout-filled bags as scour protection below a Corps navigation dam.

Grout-filled bags were also model tested during a study of Dashields navigation dam on the Ohio River and proved to be an effective scour protection plan. Results from the model studies have revealed that use of grout-filled bags depends on:

- a. The project operation schedule.
- b. Flow conditions that exist or that could be expected to occur at the project.
- c. The existing topography upstream and downstream from the structure.

Other factors that would need to be considered when considering use of grout-filled bags include:

- a. Cost of alternative methods that would provide adequate protection.
- b. Access to project.
- c. Time required to deliver and place the grout.

Information regarding the fabric bags themselves can be obtained from the manufacturer:

Intrusion-Prepack Incorporated
1705 The Superior Building
Cleveland, Ohio

COSTS: The following tabulation is the unit price schedule from the rehabilitation work at Emsworth Locks and Dams:

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
Excavation (underwater)	500	cu yd	50.00	25,000
Filter fabric	620	sq yd	21.50	13,330
Bedding material	220	tons	42.00	9,240
Graded stone	780	tons	35.00	27,300
Grout-filled bags	500	cu yd	350.00	175,000
Grouting voids in stone overlay				
a. First 700 cu yd	700	cu yd	100.00	70,000

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
b. Over 700 cu yd	300	cu yd	85.00	<u>25,500</u>
			TOTAL	\$345,370

ENVIRONMENTAL CONSIDERATIONS: Monolithic forms of bank protection tend to be ecologically inferior to stone riprap because the numerous cracks, crevices, and interstitial voids in riprap provide habitat for a wide variety of aquatic organisms. However, the localized use of grout-filled bags in extremely high energy zones instead of stone would eliminate only a small amount of relatively low-quality habitat.

An environmental concern associated with use of grout-filled bags is potential dewatering of river reaches below stilling basin during repair work. Efforts should be made to provide flows that do not interfere with repair work but that do prevent downstream dewatering. If dewatering is unavoidable, then consideration should be given to: (a) performing repair work during the fall to avoid impacting spring-time spawning or causing summertime water quality problems (increased temperature, stagnation, etc.) and (b) performing repair work as quickly as is reasonably possible.